

ON THE RESISTANCE OF GYPSY MOTH EGGS (*LIPARIS DISPAR* L.) TO COLD AND OTHER CONDITIONS.BY WILLIAM REIFF, HARVARD UNIVERSITY.¹

In the "Illustrierte Wochenschrift für Entomologie," Neudamm 1897, N. Kulagin has published a paper entitled "Zur Biologie von *Ocneria dispar* in Russland," in which the author says that a lowering of the temperature to -40° R. does not have any injurious effect on normally laid eggs of this moth. Eggs which are deprived of their protecting wool, however, will be killed by -15° R. ($= -18\frac{3}{4}$ C.) Concerning the method of procedure in these experiments, Prof. P. Bachmetjew obtained more exact information from N. Kulagin by letters, which he includes in the first volume of his well-known "Experimentelle Entomologische Studien," Leipzig, 1901, p. 70. He says in this place that Kulagin depilated the eggs and left them for one month in a glass dish upon an open balcony. During this time the thermometer not infrequently reached -15° R. In the spring these eggs did not develop, although there were caterpillars hatching from other eggs kept upon the same balcony, but which were attached to a piece of wood with their hair. The question was left open as to the result of leaving eggs covered with hair during the winter in a dish of glass.

I was induced by these investigations to undertake in October, 1908, the following experiment: From *dispar* egg clusters obtained at Forest Hills, Mass., there were selected five clusters so divided that each egg cluster was separated into three nearly equal parts. One part of each five clusters was attached with good glue to a barked piece of wood and the second thirds of each were lightly pasted to the bottom of five open glass dishes, while the eggs of the last five thirds were entirely depilated and put into five other glass dishes. All three series remained constantly at the outside temperature, but protected from snow and direct contact with water. Two other egg clusters were divided in two nearly equal parts and one part of each cluster was put into a rather small wooden box, from which the cover had been removed. The eggs of the two remaining parts were depilated entirely and then placed separately in two other wooden boxes without covers.

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All four boxes were sunk into the ground about three centimeters deep in an entirely open and unprotected place where they were allowed to remain. Snow and water were allowed free admittance to the eggs, but care was taken to allow the water to run off to a slight extent by means of a few very small holes which were cut in the bottom of the boxes.

A self-registering thermometer used recorded -21.5° C. as the lowest temperature of the winter 1908-09.

During the latter part of May, 1909, *the caterpillars from the eggs of all the series began to hatch simultaneously*. An examination made of all eggs which failed to hatch showed that *all* parts of the individual egg clusters presented about the same very small proportion of empty, dead or dried eggs, in each case a percentage of 5-8%.

The first result obtained which deserves notice, is the fact that the series of eggs which were deprived of their protecting hairs and passed the whole winter in glass dishes, withstood the cold just as successfully as those which had overwintered on a piece of wood covered with hairs in the normal way. If in Kulagin's experiment, the depilated eggs died which were exposed to the winter temperature for only one month in a glass dish probably the stated maximum temperature of -15° R. was more frequently reached, as Kulagin says himself, and perhaps also the temperature remained more constant. A continuous low temperature, however, did not occur in this locality during the winter of 1908-09, during which the temperature often fell very low but always rose again. It appears from this that the dispar eggs, from which the woolly covering has been removed, can withstand quite severe cold without injury, provided that this temperature does not endure too long. Or perhaps may it be that the woolly covering of the eggs laid by the female dispar, which withstand the very cold winter of Russia is stronger and thicker than we find here? If this be the case, the depilated eggs of Russian masses should exhibit a slighter resistance, for the eggs on account of the thick covering should be less accustomed to cold.

How very resistant the dispar eggs may be to the various influencing factors of the winter, is shown by the last two series of experiments, in which even depilated eggs withstood snow and water as well as low temperature without damage. To consider the practical application of these experiments, it appears that dispar eggs which have been removed from their normal location through some accident and have

fallen singly to the ground, can easily withstand the winter even without their protective covering. Simply tearing off the eggs from their attachment, which is occasionally done in private yards and similar places, has absolutely no effect in killing the eggs.

In connection with these experiments something may be said concerning the sporadic diffusion of the Gypsy moth in the New England States. As is well known, *Liparis dispar* frequently makes its appearance in places far removed from any sort of traffic, for example in the middle of a wooded area, in which any introduction by railroads, vehicles or other means of transportation is entirely excluded. There has hitherto been no explanation of the way in which the gypsy moth reached these isolated places. I will pass over the supposition, which one hears here and there, but which cannot be taken seriously, that birds drop caterpillars, which they have previously picked up, and thus aid in the spread and dissemination of the gypsy moth. In the first place, a caterpillar which had been dropped from the bill of a bird, would be in so very few cases so slightly injured that it could develop into a moth, and in the second place, at least one male and one female caterpillar would have to be dropped in precisely the same place to provide for the possible establishment of a *dispar* colony. Also the explanation of dissemination by the dropping of a fertilized gravid *dispar* female in the same manner is not at all plausible. The *dispar* females almost always deposit their eggs immediately after fertilization has taken place, so that the chance of birds capturing a fertilized female with eggs is very improbable. Furthermore a dropped *dispar* female, injured by a bird's bill would hardly be able still to lay its eggs.

Lately there has appeared in the fifth edition of the "Naturgeschichte der deutschen Vögel" by C. G. Friderich, Stuttgart, Verlag für Naturkunde Sproesser & Nägele, 1905, a highly interesting paper by Alexander Bau "Ueber Nutzen und Schaden der Vögel und über Vogelschutz." A short report of this article is given in No. 35, Vol. XVIII of the "Entomologische Zeitschrift," Guben (Germany) 1905. As a result of very exact investigations, which the author undertook and for which he was particularly well fitted through his extensive experience as entomologist as well as ornithologist and forester, Alexander Bau reached the conclusion that the assumed economic benefit of insectivorous birds should be constantly questioned. The part of his paper of perhaps the greatest interest deals with examinations of the